ment. The predominating cell is the mononuclear, but the higher the cell count the greater the admixture of polynuclear elements.

The globulin content of the fluid is increased in about 45 per cent. of the cases.

The fluid of patients with cerebrospinal syphilis reduces Fehling's solution in about 95 per cent. of the cases, but this has practically no diagnostic value, as the fluid taken from patients who have any organic nervous disease does the same thing. When a fluid does not reduce Fehling's it will be usually found to contain a large proportion of polynuclear cells.

Tabes. Lymphocytosis is the most constant alteration of the spinal fluid (75 per cent.). The number of lymphocytes in some instances suddenly increases while the patient is under active treatment.

The next most constant alteration is a + Wassermann (73 per cent.). The globulin is increased in 50 per cent. of the cases.

General Paresis. The cerebrospinal fluid gives a + reaction in 80 to 85 per cent. of the cases; an increase of the cellular elements in practically the same percentage and globulin increase in about 65 per cent.

The colloidal gold test is positive in 97 per cent. of the cases.

SPONTANEOUS PNEUMOTHORAX.

By Louis Hamman, M.D.,
BALTIMORE, MARYLAND.

Pneumothorax is always secondary to disease of the lungs or of the chest wall, and therefore is a complication and never a primary condition. As a rule the disease to which it is secondary is obvious, but occasionally the pneumothorax dominates the clinical picture and the primary condition is obscure and in a measure unimportant. Pneumothorax occurring when the lungs are relatively healthy may cause such trivial symptoms as to be entirely unsuspected and its presence be revealed in the course of a routine examination. Although the physical signs of pneumothorax are straightforward enough, still if one is off guard they may be overlooked or misinterpreted.

My own experience with pneumothorax, until I made the observations herein recorded, had been gained by encountering it in cases with gross and obvious pulmonary disease or after injury to the chest wall. In these instances the symptoms were marked and the physical signs, though interesting, still were quite clear and direct in their significance. I was unprepared, therefore, for the following observation, which aroused a keen interest:

CASE I.—*A young man during a cold has sudden pain in the right side. A few days later, December 2, 1909, examination reveals a complete right pneumothorax. Uneventful recovery in six weeks. On November 4, 1910, after lifting a weight, pain in the left side. Examination reveals complete left pneumothorax. Uneventful recovery in four weeks. Recurrence of left pneumothorax on December 24, 1910. In October, 1913, cough, sputum, signs of tuberculous infiltration in both upper lobes; tubercle bacilli in sputum.*

Dispensary No. 5074. A. G., white male, aged twenty-two years, elevator constructor, came to the Phipps Dispensary of the Johns Hopkins Hospital on November 12, 1909, complaining of cough and pain in the lower right side. His father had been killed in an accident, his mother was living and well. He had four brothers and one sister all living and well; no history of tuberculosis in the family.

Patient had always been a healthy man and had had no serious illness since childhood. He had been a hard worker, smoked moderately, and did not abuse alcohol. He had had a cough for two years, dating his illness from a cold which he had contracted at that time. He had never had any constitutional symptoms. A few weeks before coming to the hospital he had contracted a fresh cold, and since then his cough had been worse, and he had had some pain in the right side. His average weight had been 123 pounds. On admission the temperature was 98.2°; pulse 72; respirations 22; weight, 130½ pounds; height, 5 feet 5¾ inches. The note of the examination on admission is as follows:

Patient is a well-nourished man of healthy appearance; his skin is rather pale, but the mucous membranes are good color. Tongue is slightly coated; teeth are in bad condition and there is definite pyorrhea. The mucous membranes of the throat are reddened and the left tonsil somewhat enlarged. The cervical glands are palpable, but are not particularly enlarged. There is no general glandular enlargement. The chest is well formed, right clavicle a little more prominent than the left; movement somewhat restricted over the right side. Tactile fremitus well felt on both sides, more marked on the right than on the left. The percussion note is a little impaired above and below the right clavicle and in the supraspinous fossa and at the extreme base. A few fine rales and an occasional medium moist rale heard over the area of impairment. Heart: the point of maximum impulse is in the fifth interspace, inside the nipple line; sounds are clear. Abdominal examination shows nothing noteworthy.

December 4, 1909. Patient felt well until the afternoon of November 28, when upon stooping over he suddenly experienced a sharp pain in the right side, followed by shortness of breath The shortness of breath was not urgent, but he could not walk a block without stopping to catch his breath. Since then he has had pain in the side constantly and is unable to lie on his back or on the right side on account of the pain. The shortness of breath has continued but occurs only upon exertion.

December 2. It was noticed that the breath sounds were absent over the right side, but the examination on that date was incomplete and the true condition was not made out.

Examination.—The patient is perfectly comfortable and walks about the dispensary without the least sign of distress. Pulse 90, respirations 20. The chest well formed and fairly symmetrical; both clavicles are prominent, the right perhaps a little more so than the left; movement about equal on the two sides, a little less on the right, but the difference is not striking. Fremitus is better felt over the upper right back than on the left side, but elsewhere, though felt, is distinctly diminished as compared with the left. The percussion note is a little impaired above and below the right clavicle and in the interscapular area. Over the lower front, and particularly below the angle of the scapula, the note has a distinct hyperresonant quality. On the left the lower border of the lung, in the midaxillary line, gives an excursion of 6 cm. on deep inspiration. On the right the lower border of resonance extends to the level reached by the lung on the left on full inspiration, and this point shows no respiratory variation. When the patient lies down the hyperresonant quality of the percussion note over the front is still more marked than when he sits up. On auscultation the striking feature is the suppression of the breath sounds. They are everywhere audible, but very distant and faint. The voice sounds are somewhat diminished in intensity, but show no alteration in quality. The point of maximum impulse is in the sixth interspace outside the mammillary line, and there is no cardiac dulness to the right of the sternum; heart sounds are clear. The roentgenogram shows a complete right-sided pneumothorax, with marked dislocation of the mediastinum. The tuberculin tests—1 per cent. and 5 per cent.—conjunctival, and cutaneous tests are all negative; the sputum shows no tubercle bacilli.

December 14. Patient has been feeling much better; he has no pain now and can lie with comfort on the right side. He walks with little discomfort; he has a little cough and expectoration. Examination shows the point of maximum impulse to be distinctly farther to the right, in the sixth interspace, just inside the mammillary line, 8 cm. from the median line. The percussion note is not so hyperresonant as before; indeed, there is little difference in the note on the two sides. Fremitus is almost as well felt on the right as on the left side. The lower border of the right lung moves 3 cm. on deep inspiration in the midaxillary line. The breath sounds, though distant, are better heard than on the previous examination. The whispered voice sounds have a distant bronchial quality. The deep inspiration following cough is accompanied by numerous fine moist rales heard over the whole front. Roentgenogram shows that the right lung is beginning to expand.

December 31. Patient now feels well and is anxious to return to work. He has taken his temperature regularly during the past month, and it has never been over 99°. His pulse has been around 90. He still has a little pain in the chest when he stoops over. Examination now shows the percussion note to be resonant over the right side, with a little impairment above and below the clavicle and in the upper interscapular area. Breath sounds are vesicular and distinctly heard over the whole side, although not as loud as on the left. A few coarse, moist rales are heard on deep inspiration. The lower border of the lung moves 6 cm. on deep inspiration in the midaxillary line. The point of maximum impulse is in the fifth interspace, 7.5 cm. from the median line. The roentgenogram shows that the lung has completely expanded. There is marked increase in the mediastinal shadows and of the radiating bands to both upper lobes, particularly to the right. Three sputum examinations have been negative for tubercle bacilli.

November 8, 1910. Patient returns to the dispensary saying that on November 4, after lifting a weight, he suddenly experienced pain in the left chest. Since then he has had some pain in the side, but he has practically no shortness of breath or other discomfort.

Examination. Patient looks comfortable; there is no dyspnea. Pulse and respirations not increased in rate. The left side of the chest is fuller than the right, although there is little movement seen on the left side. The note over the left chest is hyperresonant, but not markedly so. There is practically no cardiac dulness to the left of the sternum. Breath sounds on the left side are almost entirely absent. On the right they are loud and harsh. On the right the lower border of pulmonary resonance descends 6 cm. on full inspiration. On the left resonance extends to the same level as resonance on the right in full inspiration and this point does not change on inspiration and expiration. Litten's sign is well seen on the right; it is absent on the left. Roentgenogram shows a definite pneumothorax on the left side. The upper lobe is only partially collapsed; the lower lobe more markedly; there is moderate displacement of the heart to the right.

November 23. Patient has been feeling well, and has had practically no dyspnea. Percussion note is now resonant on both sides and the breath sounds heard with normal intensity over the left. The roentgenogram shows that the lung has completely expanded and that the heart has returned to its normal position.

December 10. Has felt perfectly well except that he caught a cold last week and has had some pain, generally distributed over the chest. At present he has considerable cough and a little morning expectoration. He thinks the expectoration comes mainly from the nose. A sputum examination has been negative.

Examination. Patient looks well; the lips and nose are a little blue, but the morning is cold. The right clavicle is a little more prominent than the left, and the right shoulder droops a little. The left shoulder moves a little more freely than the right; the lower part of the right chest moves a little more freely than the left. The note is everywhere resonant, except there is a little impairment above and below the right clavicle and in the right supraspinous fossa. The lower border of the lung in the midaxillary line moves 6 cm. on the right and 5 cm. on the left on full inspiration. Fremitus is everywhere well felt, somewhat better on the right than on the left side. The breath sounds are everywhere loud and vesicular, rather harsh over the right upper lobe. The point of maximum impulse is in the fifth interspace just inside the mammillary line; there is a normal area of cardiac dulness.

December 27. Patient returns, stating that on the evening of December 24, while sitting quietly in a chair, he was taken suddenly with a sense of discomfort in the left side, which gradually increased in severity, particularly when he attempted to lie down. At present he has no pain except when he stoops over. On walking fast he has some pain in the left side and is a little short of breath, otherwise he has no dyspnea.

Examination. The patient looks well. The left side is more prominent than the right; it moves with respiration, but less than the right. The left chest is hyperresonant throughout. Fremitus is absent on the left side, and the breath sounds are absent except in the interscapular area, where they are very distant, and have a slight amphoric quality. The point of maximum impulse is seen just to the left of the lower end of the sternum. The roentgenogram shows a well-marked pneumothorax on the left side, with marked dislocation of the mediastinum to the right. The lung is generally although not completely collapsed.

January 14, 1911. Patient has been feeling quite well, although the cough has at times been troublesome. He has had very little shortness of breath except when he attempts to walk rapidly. He has no pain in the chest except on lying down. He has taken his temperature regularly during the past two months, and it has never been over 99°. Pulse ranges from 72 to 104, but is usually in the neighborhood of 80. Examination shows the movement to be good on both sides, only a little limited on the left. The note is a little hyperresonant over the whole left side, but nowhere tympanitic. Breath sounds are still almost completely absent. Fremitus is felt, but diminished in intensity. The whispered voice sounds are very distant with a suggestion of metallic quality. The roentgenogram shows the pneumothorax has largely cleared up, although the lower lobe is not yet completely expanded.

February 4. Patient feels well. He has at times fleeting pains about the chest. The heart is now in its normal position and the signs of the pneumothorax have entirely disappeared. All over the left front and over the upper left back numerous fine superficial scratchy rales are heard on deep inspiration.

February 18. Patient is feeling exceptionally well and is anxious to return to work. The physical signs show, as they have on all previous examinations, a little impairment and harsh breathing over the right upper lobe. The cutaneous and conjunctival tuberculin tests repeated on January 30 showed absolutely no reaction.

November 21. Patient was well until one week ago, when he began to have pain over the right front of the chest. Pain came on after slipping and straining his chest. Since then the pain has persisted, and he comes thinking a pneumothorax has developed again. He has a little cough and the pain is aggravated on coughing. He has taken his temperature the last few days, and it has constantly been a little over 99°. Patient looks well, his color is good, and he is in good spirits. Examination shows no evidence of pneumothorax. The percussion note is a little impaired above and below the right clavicle and in the supraspinous fossa where breath sounds are harsh and shrill. Over both the lower front and back there are a few coarse moist and a few fine crackling rales.

March 29, 1913. Patient comes complaining that for the past three or four days he has had severe pain in the lower left chest. The pain is particularly severe when he lies down. Last night he was unable to sleep on account of it. He thinks he has had a recurrence of the pneumothorax.

Examination. The patient looks well; is a little blue, probably from the cold. Percussion note is everywhere resonant, except for slight impairment over the right upper lobe. The heart is in its normal position. The lower borders of both lungs move freely on inspiration. Over the left lower front there is a shower of fine moist rales on deep inspiration.

August 2. About ten days ago patient was suddenly taken with severe pain in right side of chest. The following day on stooping over the pain was so severe that he fainted. His family physician told him the pain was due to pleurisy, and says he found tubercle bacilli in the sputum.

Examination. The patient's general appearance is as it has always been, quite good. Besides the impairment which has been heretofore noted on the right side, there are numerous moist and a few sonorous and sibilant rales over the whole front and in the supraspinous fossa in back. The sputum contains numerous tubercle bacilli. Patient admitted to the State Sanatorium.

April 25, 1914. Patient was at the State Sanatorium from August 27, 1913, to April 12, 1914. He has improved somewhat in his general condition, and has less cough and expectoration. The physical examination now shows impairment on the right to the third rib and fifth dorsal spine with harsh, blowing breath sounds and fine moist rales over whole front and to the sixth dorsal spine in back. On the left there is a little impairment above and below the clavicle, and in the back down to the third dorsal spine with roughened breath sounds and moist rales above and below the clavicle and in the supraspinous fossa.

While the case above detailed was under observation I had the opportunity of seeing another instance of pneumothorax coming on in a healthy young man without apparent cause which ran an almost symptomless course and subsided completely in a few weeks:

CASE II.—*Healthy young man has sudden pain in left side of chest followed by dyspnea on exertion; examination the following morning, November 30, 1910, reveals complete left pneumothorax; uneventful recovery in four weeks; has remained well since.*

White male, aged twenty-nine years, came to me for examination on November 30, 1910. There was nothing of importance in the family history. He had always been strong and healthy, except that since childhood he had had attacks of renal colic often associated with hematuria. Detailed examination had shown a large left hydronephrosis with almost complete absence of renal function on that side. On the evening of November 29, as he was leaving his house after dinner, he suddenly felt a sharp pain in the left side, followed by a sensation as though something had given way. He went to his office and again experienced the pain, especially on movement. He felt as though inspiration did not fill out the left lung; as he expressed it, "as though air went only half-way down the chest." However, he did not feel ill and had no shortness of breath. He attended a meeting of the Bar Association, after the meeting enjoyed a light collation, and then walked with a friend to his club, about two miles away, and sat there reading until midnight. On the morning of November 30, as he left home, he again experienced the curious sensation in the left side. He had an appointment on that morning to have Roentgen-ray pictures taken of his kidneys; he reported to Dr. Geraghty for this purpose, who postponed the investigation when he heard of the patient's symptoms, and sent him to me for examination.

Patient was a large, well-nourished man of good color and healthy appearance. Chest well formed and symmetrical. Inspection revealed at once a marked difference in movement on the two sides of the chest, the right moving freely, the left very little. Percussion note was resonant over both sides—a little hyperresonant over the left, though the difference between the two sides was not marked. The breath sounds were absent over the left side. On the right the lower border of the lung was at the eighth rib in the axillary line and the lower border moved 8 cm. on deep inspiration; on the left the lower border of resonance was at the tenth rib and did not move on deep inspiration. The point of maximum impulse was not definitely visible. There was very little cardiac dulness to the left of the sternum. The heart sounds were much louder on the right than on the left. Roentgen-ray examination showed a well-marked pneumothorax on the left side. The upper lobe markedly collapsed; the lower lobe widely separated from the diaphragm, but adherent to the chest wall in the axillary area at about the fifth rib. The heart moderately displaced toward the right.

December 19. Patient spent a week in bed and then began going about. He has had absolutely no fever, and the pulse and respiration rate have been normal. He has felt perfectly well except for a feeling of uneasiness in the left side when he bends over.

Examination. There is still considerable diminution of movement on the left side. Fremitus is well felt on the left but not nearly so well as on the right side; the breath sounds are heard on deep inspiration, and are then vesicular in quality. Over the lower front and below the angle of the scapula behind there are numerous fine moist crackling rales on deep inspiration.

January 1. Roentgen-ray examination shows that the pneumothorax has completely cleared up. The mediastinal shadows are dense and broad shadows radiate from the mediastinum toward the periphery. The shadows are denser in the right upper lobe than elsewhere. The heart is in its normal position.

January 7. Patient feels quite well; he has taken his temperature continuously and has had no fever. Occasionally he has a stitch in the left side.

Examination. Movement is almost equal on the two sides, perhaps a little diminished on the left. The left clavicle is a little more prominent than the right. Percussion note is everywhere resonant and the breath sounds are loud and vesicular on the two sides. At the left base there are a few fine rales on deep inspiration. The *A. r. z.*—right, 6 cm.; left, 7 cm. The 1 per cent. conjunctival tuberculin test is negative; the cutaneous test gives a slight reaction.

January 1, 1915. Patient has been seen frequently since his recovery from the pneumothorax. He has remained well, has had absolutely no pulmonary symptoms, and the examination remains unchanged.

During the past year I have seen three more cases in many respects similar to the two described. Two of these are almost identical with Case II, while the other presents interesting points of difference.

CASE III.—Dispensary No. F. 9082.

Healthy patrolman, aged thirty-eight years, has sudden pain on left side, followed by dyspnea on exertion; examination reveals left pneumothorax; uneventful recovery in four weeks; has remained well.

White male, aged thirty-eight years, came to the Johns Hopkins Hospital Dispensary July 7, 1913, complaining of severe pain in the left side. The family history contains nothing of importance. The patient has always been a healthy man, and has had no serious illness since childhood. He is a patrolman and works at night. On the morning of July 4, patient reached home early in the morning and went to bed. About noon, when he arose, he had severe pain in the left side of chest. However, in the evening he went to work as usual, but noticed on making his rounds that he was rather short of breath. Since then whenever he lies down or walks he has noticed the shortness of breath. During this time he has had pain in the left side.

Examination. Patient is a large, well-nourished man of healthy appearance. Mucous membranes are good color; no general glandular enlargement. Teeth are in bad condition and there is well-marked pyorrhea. Chest is well formed, though for a man of his build is rather long and narrow. The shoulders droop considerably, the left a little more than the right. The costal angle is about 80 degrees. The clavicles are equally prominent. Movement is markedly restricted throughout the left side. Percussion note over the right lung is normally resonant and the breath sounds are everywhere vesicular. There are a few fine moist rales over the lower front and in the lower axillary area. The lower border of the right lung is at the eighth rib in the axillary line and moves 6 cm. on deep inspiration. In the back the lower border of the lung is at the eleventh dorsal spine, and there is an excursion of 6 cm. between deep inspiration and full expiration. Over the whole left side of the chest the note is hyperresonant and rather drum-like in quality. The lower border of resonance is at the ninth rib in the axillary line. This point does not change with respiration. In the back the lower border of resonance is at a point between the twelfth dorsal and first lumbar spine and does not move with respiration. Fremitus is absent over the whole left side. Above the clavicle the breath sounds have a distant amphoric quality; elsewhere they are inaudible. The whispered voice sounds are scarcely audible over the upper portion of the chest, while in the axillary area and below the angle of the scapula they have a distinct, ringing, metallic quality. Cardiac pulsation is seen to the right and left of the sternum; cardiac dulness extends 5.5 cm. to the left and 6.5 cm. to the right of the median line. Heart sounds are clear, much louder on the right than on the left of the sternum. The pulse is slow, 76 to the minute, good size, regular. The vessel wall is palpable. Abdomen is normal in appearance; no rigidity; no tenderness. The liver is not felt; area of liver dulness is not enlarged. Spleen is not felt; area of splenic dulness is not enlarged.

July 19. Patient feels well. When lying down or walking he often has a sensation of rubbing over the left lower front. He walks about now with little discomfort. The percussion note is less hyperresonant on the left than it was at the first examination, and the breath sounds are audible over the left upper front. Cardiac dulness extends 8.5 cm. to the left and 4.2 cm. to the right of the median line.

August 2. Patient feels fairly well. He still has a little pain in the chest, and at times he has shortness of breath when he walks rapidly. The percussion note is now almost equal on the two sides. Fremitus is still somewhat diminished in intensity on the left, but it is well felt everywhere. Breath sounds are audible over the left side, not so loud as on the right, and are accompanied by a profuse shower of fine moist rales over the lower front. Cardiac dulness extends 9 cm. to the left and 3.5 cm. to the right of the median line. There is a distant pleuropericardial friction rub to the left of the ensiform.

September 1, 1914. Patient has not returned for examination, but in reply to a letter states that he has remained perfectly well.

CASE IV.— *Young man, aged thirty-five years with relatively inactive chronic pulmonary tuberculosis, suddenly has severe pain in the left side. Examination reveals left pneumothorax. No constitutional symptoms develop and the pneumothorax heals uneventfully in five weeks.*

White male, aged thirty-five years, came for examination on October 1, 1912. There is a marked history of tuberculosis in the family. Patient has always been well but never robust, subject to frequent colds, some continuing rather obstinately. During the previous spring he had had grip, and his physician found evidence of tuberculous trouble in the chest.

Examination. Patient is a sparely nourished man of good color but looks below par in health. Pupils are equal and react actively to light; eye movements are all normal; no general glandular enlargement. Chest is long and thin, the right clavicle a little more prominent than the left, right shoulder sags a little and a little curvature of the spine to the right in the upper dorsal region; diminution of movement over the right upper. On the right the note is impaired above and below the clavicle and in the supraspinous fossa; breath sounds are a little blowing in quality, and after coughing there is a small number of fine moist rales to the third rib in front and to the fourth dorsal spine in back. On the left the percussion note in impaired to the second rib and in the supraspinous fossa; breath sounds are harsh and a little blowing; a medium number of fine moist rales to the second rib in front and to the fourth dorsal spine in back. Opposite the second and third dorsal spine the whispered voice sounds have a bronchial quality. Area of cardiac dulness is not enlarged; heart sounds are clear. Abdominal examination shows nothing noteworthy.

January 5, 1914. Patient has been well except for occasional attacks of abdominal pain which were diagnosed appendicitis and in July, 1913, the appendix was removed. Since the operation patient has been very well and has gained somewhat in weight. He never has cough and has not had any expectoration. Yesterday afternoon, after dinner, he had a sudden, sharp pain in the left lower axillary region associated with a feeling as though he wanted to take a deep breath. He went home without any distress, but feeling chilled got into bed. After a few hours he felt perfectly well except that on deep breathing and movement there was some pain on the left side. During the night patient had some pain over the whole left side, radiating to the left shoulder.

Examination. Patient is lying comfortably in bed. He says he feels perfectly well, except there is a little pain in the left side when he turns over. Patient looks well and is in good spirits. Temperature 98.2°; pulse 78; respirations 18. The chest is symmetrical. The movement is markedly restricted on the left side. The percussion note at once attracts attention, being markedly hyperresonant throughout the left side. The lower border of resonance in the anterior axillary line is at the ninth rib; in the back at the twelfth dorsal spine, and these points do not move on deep inspiration. Fremitus is felt all over the left side, but is markedly diminished in intensity. Above and below the clavicle and in the supraspinous fossa breath sounds are plainly audible, distant, and blowing in quality. Over a small area in the second and third interspace in the anterior axillary line there is frank and loud tubular breathing; elsewhere over the chest breath sounds are inaudible. The whispered voice sounds are diminished in intensity everywhere over the side without change in quality. Over the small area in the second and third interspace where the breathing is tubular there is frank bronchophony. On the right percussion note is resonant except there is a little impairment above and below the clavicle and in the supraspinous fossa. The breath sounds are loud and vesicular in quality. After coughing there are moist rales to the second rib and to the fourth dorsal spine. The lower border of pulmonary resonance is at the seventh rib in the anterior axillary line, in back at the eleventh dorsal space; the border moves freely with respiration. Cardiac pulsation is seen to the right and to the left of the sternum. Cardiac dulness extends 5 cm. to the left and 6 cm. to the right of the median line. Heart sounds are louder to the right than to the left of the sternum.

January 20. After spending a few days in bed the patient got up and has been going about. During this time he has had absolutely no fever and the pulse and respiratory rate have been normal. He has a little shortness of breath on exertion and some dull pain over the left side. The percussion note over the left front has completely lost its hyperresonant quality, but hyperresonance persists over the left back below the angle of the scapula. Fremitus is still much diminished in intensity. Breath sounds are now audible over the upper front and the whispered voice sounds are better heard. The lower border of pulmonary resonance is at the eighth rib in the axillary line and there is an excursion of 4 cm. on deep inspiration. Heart dulness extends 10 cm. to the left and 4 cm. to the right of the median line.

February 21. Patient now feels perfectly well except that at times he has a little twinge of pain on the left side. Examination shows that the pneumothorax has completely disappeared and the conditions are the same as they were on examination before the onset of the pneumothorax. On the right the note is impaired to the second rib and to the third dorsal spine and there are rales after coughing to the second rib and to the fourth dorsal spine. On the left the note is impaired to the second rib and to the fourth dorsal spine, and moist rales are heard after coughing to the third rib and in back down to the angle of the scapula.

December 12. Patient has been quite well; he has gained a little in weight; he never has cough or sputum; indeed, feels that he is in very good health and the pulmonary examination shows the same conditions as on February 21.

CASE V.—*A healthy man, aged twenty-nine years, suddenly has severe pain in the right side on the morning of July 29, 1914, followed by a little dyspnea on exertion. Examination on August 17, 1914, reveals a right-sided pneumothorax which has almost completely cleared up. Patient has remained well since then.*

H. T., white male, aged twenty-nine years, came for examination on August 17, 1914. There is nothing of importance in the family history. The patient, though never robust, has always been healthy. Whooping cough, measles, and scarlet fever in childhood; no serious illness since. On the morning of July 29, the patient took an early train and went into the diner and ordered breakfast. He was feeling in his usual good health. While sitting at the table he suddenly had a catch in his right side, which bent him over and immediately after he had a feeling of oppression and some difficulty in getting his breath. The pain in the side was increased whenever he took a deep breath. Following this the patient had a little cough and a little expectoration. The sputum has been examined a number of times and tubercle bacilli have not been found. His temperature has been taken frequently and occasionally has been a little above normal. The pain in the right side has almost completely disappeared although he still complains of a little soreness. During the past week he has had no shortness of breath on ordinary exertion.

Examination. Temperature, 98°; pulse, 80; respirations, 20; weight 114½ pounds; height, 5 feet 9 inches. Patient is a sparely nourished man. His complexion is a little sallow; mucous membranes are good color. Pupils are equal and react actively to light. Eye movements are all perfectly normal. Teeth are in good condition, there is considerable dentistry; no pyorrhea. The throat is a little injected; there is no gross abnormality. Posterior cervical glands are all easily palpable but not markedly enlarged; the glands below the angle of the jaw on both sides are a little enlarged; the epitrochlear glands are just felt; the axillary glands are easily felt.

The chest is long and rather thin; the costal angle is about 80 degrees; the right shoulder is considerably lower than the left and the right clavicle a little more prominent. Movement is diminished over the right side. The spine is straight. Percussion note over the right front is a little hyperresonant in quality. On the left it is normally resonant, the difference between the two sides being by no means marked. The lower border of resonance is at the ninth rib on the right side; at the eighth rib on the left in the midaxillary line. On the left side the lower border of resonance shows a movement of 5 cm. on deep inspiration, whereas on the right there is none, or at most not more than 1 cm. of movement. Fremitus is well felt over the right side, but it is diminished as compared with the left. On quiet breathing breath sounds are entirely absent over the right side; on deep breathing they are very faint and distantly tubular in quality. The whispered voice sounds are diminished in intensity, but have a distant bronchial quality, and just below the calvicle they have a slight metallic quality. On the left breathing is everywhere loud and vesicular; no rales are heard. Heart: The point of maximum impulse is in the sixth interspace just inside the nipple line. Cardiac dulness extends 11 cm. to the left of the median line; there is no cardiac dulness to the right. The heart sounds are perfectly clear. They are absent to the right of the sternum. Abdomen is normal in appearance; abdominal wall is soft and relaxed. Liver is not felt; liver dulness does not extend below the costal margin. Spleen is not felt; area of splenic dulness is not enlarged. The right kidney is just palpable; the left is not felt. Pulse is regular, good volume and good size; the vessel wall is not thickened. Blood-pressure: systolic, 120; diastolic, 70. Roentgen-ray examination shows pneumothorax of the right side. However, the lung has expanded so that at some points it has almost reached the chest wall. Marked increased density of the mediastinal shadows and of the shadows generally throughout the lung. There is slight clouding and flattening of the left apex.

November 1, 1914. The patient has not been seen again, but reports that he has remained perfectly well.

DISCUSSION. These five cases are of interest, since they illustrate (1) how insidious may be the onset of pneumothorax; (2) what few symptoms it may occasion; (3) how easily upon a casual examination the condition may be overlooked; (4) the perfectly benign course of the affection; (5) the occurrence of an insidious benign type of pneumothorax in perfectly healthy individuals as well as in those with manifest pulmonary disease.

This benign type of pneumothorax coming on without apparent cause and subsiding uneventfully has received a fair share of literary attention. The condition has been frequently described in England, less commonly in France, only occasionally in Germany, and though there are a few good accounts of it in American literature, still it has not attracted wide consideration. Fussell and Riesman[15] reviewed the literature of spontaneous pneumothorax in 1902 and analyzed 56 cases. Nikolsky,[29] in 1912, collected 90 cases from the literature. Some authors emphasizing the obscure cause of the pleural rupture have termed the condition "spontaneous pneumothorax" (Nikolsky,[29] Emerson,[11] Bach,[3] Hamilton[20]); "idiopathic pneumothorax" (Boland,[7] Francine and Landis[14]), and "pneumothorax in the apparently healthy" (Weber,[37] Hall,[19] Male[27]), to distinguish it from pneumothorax following violence or gross pulmonary disease. Others, struck by the absence of the usual symptoms accompanying pneumothorax, have described it as "latent pneumothorax" (Bevan,[5] Stevens[36]), "pneumothorax with insidious onset" (Pepper[30]). Still others, having missed certain classical physical signs of pneumothorax, have called it "pneumothorax muet" (Yaldizdjian[41]) and "pneumothorax silencieux" (Adler[2]). Finally, many have emphasized certain salient features, using such descriptive terms as "recurring pneumothorax" (Finny,[12] Gabb,[16] Sale[35]), "pneumothorax with rapid recovery" (Coghlan,[10] Beevor[4]), "spontaneous, non-tuberculous pneumothorax" (Fussel and Riesman[15]), "curious instance of pneumothorax" (Jochmann[22]), etc.

None of the terms that have been suggested for this type of pneumothorax are satisfactory, but "spontaneous pneumothorax" is the term most commonly employed; and though it describes only one of the many important features of the condition, still it is the least objectionable, if we will accept its extension to embrace them all. In this sense spontaneous pneumothorax signifies a pneumothorax coming on in apparently healthy individuals without ascribable cause; resulting in no infection of the pleura and therefore unaccompanied by constitutional symptoms; and healing rapidly and completely in a few weeks.

As regards the meaning of "apparently healthy," I may say that most authors would exclude from the group of spontaneous pneumothorax those cases in which examination before or after the occurrence reveals definite pulmonary disease. The "non-tuberculous" nature of the condition is constantly emphasized. I feel very strongly that no such sharp line can be drawn, and I would include tuberculous cases that meet the other requirements of the definition. Case I certainly belongs to the group of spontaneous pneumothorax, and still years later he developed a manifest pulmonary tuberculosis. Both immediately before and immediately after the attacks of pneumothorax the clinical evidence was not sufficient to make a diagnosis of pulmonary tuberculosis, although in the light of later developments it seems certain that even at that time he must have had the infection. Cases II, III, and V in no way distinguishable from Case I have remained well. Case IV, though in good general condition, still had a definite pulmonary tuberculous lesion before the onset of the pneumothorax. In all other respects the clinical picture was identical with that of the *three previous cases.* The absence of grave pulmonary disease, of pleural infection, and of mechanical conditions leading to high intrapleural pressure distinguish the condition from pneumothorax as it usually occurs in pulmonary tuberculosis. Later I will speak of the mechanism of the production of the pneumothorax in spontaneous pneumothorax and here wish only to remark that in all probability the mechanism in Case IV was the same as in the previous cases, and was not due, as pneumothorax in advanced pulmonary tuberculosis usually is, to the rupture of the pleura by a tuberculous focus.

While most cases of spontaneous pneumothorax remain simple, in a small number pleural effusion develops. Cases in which the effusion is the expression of an infection must be discarded from the group, but in a certain number the fluid remains sterile, no constitutional symptoms develop, and the fluid and air are both rapidly absorbed. Such instances are reported by Francine and Landis,[14] Hamilton[20] and West.[38] In some instances the fluid is bloody, apparently due to hemorrhage at the time of the pleural rupture. Rolleston's case[34] proved fatal and no cause for the pneumothorax or hemorrhage could be found at autopsy. Pitt's patient,[31] a lad, aged eighteen years, died within thirty-six hours of the onset of pain in the side. At autopsy a ruptured emphysematous bulla was found with a torn adhesion attached near it. Boland's patient[7] recovered after aspiration of thirty-four and then thirty-nine ounces of blood. Ness and Allen's patient[25] recovered uneventfully; apparently the hemorrhage was very small.

As regards the third characteristic in the definition, rapid and complete healing, one can set no absolute limit. In most cases the pneumothorax disappears in from four to eight weeks. Occasionally the pneumothorax will persist longer than eight weeks and then clear up completely, but a duration of over eight weeks is against including the case in the group of spontaneous pneumothorax.

The changes in the lung that occasion the pleural rupture are not clinically ascertainable, but there are enough autopsies on record to make clear the mechanism in many instances. Zahn,[42] in 1891, published the first thorough study of "pleural rupture without inflammation," and described four different modes:

First, the rupture of vesicular blebs. In one case he reports there were a number of such bullæ in the region of the apex of the left lung, and upon inflating the lung one of these showed a small rent. In another instance associated with well-marked pulmonary emphysema, numerous bullæ were found on the surface of the right lung, some as large as a hen's egg; one of these showed a tear 2 mm. in length. Zahn collects from the literature similar observations by Duvilliers, Dittrich, Fraentzel, and Rheder. Rankin,[32] and Cnopf[9] may be added to the list. Bach[3] collects fifteen cases from the literature.

Second, the rupture of interstitial emphysema blebs. In these cases air enters the interstitial tissue, then reaches the pleural surface, where a vesicle is formed, which then ruptures. All such instances of interstitial emphysema have been about pleural adhesions, and the pleural adhesions are the primary condition which give the mechanical explanation for the interstitial emphysema. Zahn[42] reports two instances of pneumothorax produced by this mechanism. In both instances there was associated pulmonary tuberculosis, but the pleural rupture was about adhesions and not contiguous to tuberculous foci. He considers this the most common cause of rupture in spontaneous pneumothorax.

Third, a direct tear of the pleura by the tug of adhesions. Zahn[42] reports such a case in a suicide, and thinks the instance reported by Robertson belongs to this group.

Fourth, senile atrophy of the pleura. A man, aged sixty-one years, with extreme emphysema, showed at autopsy a number of minute openings in the pleural surface over an area where the membrane was extremely thin. Zahn remarks that he had never before seen such an extreme grade of emphysema, and he regarded the pleural atrophy to be due to pressure. I have encountered no similar observation in the literature.

We may exclude division four, since it is an unusual cause of pneumothorax, and it is a technical refinement to separate divisions two and three. Such postmortem evidence as is available, therefore, points to the rupture of vesicular emphysematous blebs and the tears produced by adhesions as the two common causes of spontaneous pneumothorax. The not infrequent finding of ruptured vesicular blebs has led some authors, for instance Bach,[3] to speak of the whole group under consideration as "spontaneous pneumothorax in emphysema." Anyone who has had a large experience with pulmonary cases will remark at once how surprisingly infrequent pneumothorax is in the frankly emphysematous. It is noteworthy that spontaneous pneumothorax is a disease of early adult life, over 80 per cent. of the instances collected by Nikolsky occurring before the age of forty years. Therefore, it is manifestly improper to regard spontaneous pneumothorax as having any direct relation to general pulmonary emphysema. When emphysema is its cause the emphysema is generally a local condition, and clinical evidence is, in my opinion, strongly in favor of adhesions being the usual condition underlying the pleural rupture.

Having in mind the mechanism of spontaneous pneumothorax, it will appear unreasonable to exclude from the group cases with pulmonary tuberculosis in which the onset and benign course of the pneumothorax and the rapid recovery are the characteristic features (such cases are reported by Coghlan,[10] Knight,[23] Hamilton[20]). There is considerable evidence to influence us to believe that tuberculosis is the commonest cause of pleural adhesions, and if this be true it is further reason against drawing too close a line between manifest and obscure pulmonary tuberculosis, a distinction that at once involves serious clinical difficulties. Of course, it is possible that an isolated tubercle situated upon the pleura might rupture and the opening be so small that it would heal promptly without the pleura becoming infected. Such an occurrence, however, must be very uncommon. Letulle reports a diabetic without evidence of pulmonary disease who developed pneumothorax. Eight days later he died suddenly and autopsy revealed a single tuberculous nodule in the lung which had ruptured. West[38] and Flint[13] report instances of pneumothorax due to the rupture of a single small tuberculous cavity. However, neither of the cases resembled clinically spontaneous pneumothorax, for West's patient died shortly after the onset of pneumothorax from exhaustion, and although Flint's patient died of pneumonia, the hydropneumothorax had persisted for a long time before.

The clinical symptoms in spontaneous pneumothorax indicate that in most instances the pleural opening is very small. Symptoms of high intrapleural pressure are seldom present, and in the two cases I followed carefully with Roentgen-ray examinations the lung was not fully collapsed. Apparently as soon as sufficient air escapes into the pleural cavity to cause an appreciable decrease in the intrapulmonary pressure the pleura is relaxed and the opening closes. The size of the opening will determine the degree of pulmonary collapse.

In the definition of spontaneous pneumothorax the salient clinical features were emphasized. Briefly, the important points are these: The condition predominates in males: 45 males to 10 females in Fussell and Riesman's[15] series and 73 males to 14 females in Nikolsky's[29] group. The vast majority of the cases occur in young adults. In Nikolsky's table two instances are under fifteen years of age, 34 between fifteen and twenty-five years, 26 between twenty-five and forty years, 11 over forty years. The right and left side are affected with equal frequency. The exciting cause in many instances is exertion, though the exertion may be slight and entirely out of proportion to the result. Not infrequently the pneumothorax comes on without any provoking cause, and in some of the reported instances it developed during sleep (Fussell and Riesman,[15] Landmann,[24], Heitler,[21] Sale,[35] Bevan[5]). Nikolsky's analysis shows that an equal number follows exertion and comes on without exertion. The insidious onset is emphasized particularly by Pepper[30] and Jochmann.[22]

The symptoms at onset vary from extreme dyspnea and collapse to disturbances so slight as scarcely to attract attention. In the instances reported in this paper, pneumothorax would not be suspected from the symptoms. Nearly always there is some dyspnea on exertion, but there is seldom distress when the patient is at rest. The mild character of the symptoms is a peculiar and characteristic feature of the condition. No doubt the size of the rupture largely determines the intensity of the symptoms. Cough is often present, but frequently is entirely absent, and is seldom troublesome. A characteristic feature of the condition is the absence of constitutional symptoms, of fever, and of other evidence of infection.

The duration of the pneumothorax varies. In most instances there is complete restitution in six weeks. Of 66 cases collected by Niklosky,[29] 59 recovered completely within two months; 6 during the third month; 3 during the fourth month. There are certain curious instances of pneumothorax that have persisted for a long time. Bittorf[6] reports a case which under his observation remained unaltered for a year and a half, and from the history he concluded that the pneumothorax had probably been present for twenty-five years. Whitney[39] thinks in his patient the pneumothorax had arisen seven years before his examination. Adams[1] patient recovered after the pneumothorax had persisted for five years.

I have found in the literature sixteen instances of recurrence of the pneumothorax (Jochmann,[22] Hall,[19] Bull,[8] Goodhart,[17] Gabb,[16] Sale,[35] Finney,[12] West,[38] Flint,[13] Knight,[23] Weber,[37] Rendu,[33] Maillart and Lasserre,[26] Wieruzski,[40] Grenier,[18] Bach[3]). Gabb's patient had four attacks all on the same side. Sale's patient apparently had eleven attacks during six years. In many of the cases the recurrence was, properly speaking, a relapse, the second attack of pneumothorax coming so promptly upon the resolution of the first as to warrant the inference that the original tear had reopened. Three of the cases are of particular interest, since, as in Case I of this report, the recurrence occurred on the opposite side. Goodhart's patient, a young man, aged twenty-four years, had a pneumothorax of insidious onset on the right side in May, 1891, another coming on in like manner in July, 1892, but on this occasion affecting the left side. He recovered from both attacks uneventfully, and was well three years, after. Wieruzski reports about a physician, aged fifty-four years, who had had bronchitis and emphysema for a long time. In the fall of 1894 he had pneumothorax on the right side that cleared up completely in about five weeks, but recurred a few weeks later. In February, 1899, he again developed pneumothorax, this attack being on the left side, which likewise cleared up in a few weeks. In September, 1899, he had another attack on the right side. Grenier gives the account of a young man, aged twenty-one years, who had a spontaneous pneumothorax on the left side in the fall of 1903. In December, 1904, he had an identical attack involving the right side, and in March, 1905, a recurrence upon the right side. Recovery from all three attacks was rapid and uneventful.

After an attack of spontaneous pneumothorax the individual may remain well indefinitely. One of Hamilton's patients was well after ten years; another after six years; Fussell and Riesman's case after seven years; Bach's three years; West's ten years. A characteristic case of spontaneous pneumothorax was in the Johns Hopkins Hospital in January, 1898.* The patient returned to the hospital in November, 1913, complaining of digestive disturbances and jaundice. During the interval he had been well and had had no pulmonary symptoms. The pulmonary examination on the second admission showed no abnormality other than a few crackling rales at the left base.

As regards the examination it is important to emphasize that in these cases the physical signs of pneumothorax stand out in classical purity. Pneumothorax is so frequently accompanied by effusion and associated with gross disease of the lungs that there is a general tendency to emphasize accessory physical signs, namely, succussion, the coin sound, metallic tinkling, and movable flatness, rather than the fundamental signs peculiar to and characteristic of the condition. Laennec's description has been weakened by unessential additions. On inspection the affected side is not strikingly prominent, but there is always diminished mobility. Fremitus may be absent, but it is usually well felt, though greatly decreased as compared with the opposite side. The percussion note may be but little altered, and the change escape notice if the examination be hurried. On careful percussion the note is discovered to be hyperresonant, sometimes with tympanitic overtones. The striking feature on auscultation is the absence or great diminution in the intensity of the breath sounds. The voice sounds are less strikingly suppressed, and at times have a curious, characteristic metallic echo.

I wish to call attention particularly to the diagnostic value of *percussion*. Percussion of the lower lung border reveals that resonance stops on the affected side at the level reached by the lung on the sound side in full inspiration. This point is stationary, showing no variation with inspiration and expiration. The extension of pulmonary resonance to the full capacity of the pleural space with absence of respiratory variations at the border is absolutely characteristic of pneumothorax without effusion. If the note is hyperresonant the hyperresonance extends in front to the opposite border of the sternum. The heart is always displaced, and its position can be determined satisfactorily only by percussion.

The diagnosis is easily made if one thinks of pneumothorax, but in the entire absence of symptoms the condition may not be suspected and the physical signs be overlooked. Case I at first attracted attention as an instance of unusually feeble breath sounds, without any satisfactory explanation for the enfeeblement. A physician experienced in the study of pulmonary disease saw this patient, and was sure he would have missed the diagnosis had the condition not been pointed out. Case III was first seen by an experienced instructor in physical diagnosis, who diagnosed a mediastinal tumor pressing upon the bronchus.

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* Reported by Osler, Maryland Med. Jour., 1898, xxxviii, 461; Case 28 in Emerson's report.

The treatment for the condition is to do nothing. The pulmonary collapse closes the pleural opening, the air in the pleural cavity is gradually absorbed, and as the lung begins to reëxpand the pleural rupture is tightly healed. Occasionally the pneumothorax recurs shortly after the lung has completely expanded, no doubt due to incomplete healing of the pleural wound.

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